

US Wind Turbine Database Summary

Version: USWTDB V3.3

Release Date: January 14, 2021

I. ACRONYMS:

AWEA	American Wind Energy Association
DOF	Digital Obstacle File
FAA	Federal Aviation Administration
LBNL	Lawrence Berkeley National Laboratory
OE/AAA	Obstruction Evaluation / Airport Airspace Analysis
USGS	United States Geological Survey
EIA	Energy Information Administration
USWTDB	United States Wind Turbine Database

II. ABOUT THE DATABASE:

In 2016, USGS, LBNL, and AWEA began collaborating on development of the USWTDB. Their goal was to create a joint product that would be more comprehensive and accurate than their individual wind turbine data sets. Federal agencies began using these combined data in March 2017, and in April 2018 the data were released to the public. The database is maintained and updated quarterly to reflect new turbine additions, removals, and changes to the data.

These data are used by government agencies, scientists, private companies, and citizens for a variety of analyses. Examples include operational impact assessments of turbines on air defense radar, weather and general aviation, analyses related to the role of wind energy in the U.S. electric grid, interactions between wind energy facilities and wildlife, and investments in wind energy infrastructure.

The data were created by combining publicly-available data sets from the Federal Aviation Administration (FAA), USGS data from a prior effort, online sources, and data privately held by AWEA and LBNL. The locations of all turbines are visually verified to within plus or minus 10 meters using high-resolution imagery. Technical specifications data of the turbines are collected from wind energy developers, equipment manufacturers, and from online sources.

III. DATA SOURCES:

Data were added, compiled, and updated in this edition of the USWTDB using the following sources:

- | | |
|--|---------------------------------|
| • USGS Onshore Industrial Wind Turbine Locations for the United States | Release Date: March, 2014 |
| • LBNL Wind Turbine Database | Release Date: March, 2017 |
| • FAA Digital Obstacle File (DOF) | Release Date: October 4, 2020 |
| • FAA Obstruction Evaluation (OE/AAA) | Release Date: November 12, 2020 |
| • AWEA Q3 2019 Wind Turbine Dataset | Release Date: October 31, 2020 |

- EIA Form 860 ER – Schedule 3 – Wind Data Release Date: June 2, 2020
- USGS Visual Verification (satellite imagery) Date: December, 2020

IV. VARIABLE CHANGES OR ADDITIONS:

Two variables were added to the database this quarter:

- **"retrofit"** - Indicator of whether the turbine has been partially retrofitted after initial construction (0 = "no", 1 = "yes").
- **"retrofit_year"** - Year in which the turbine was retrofitted (only populated where retrofit = 1).

V. VARIABLE NAMES AND DEFINITIONS:

Variable list and definitions can be found in the codebook that accompanies this release.

VI. SUMMARY OF DATASET AND CHANGES THIS QUARTER:

This edition of the USWTDB contains **67,814** turbines distributed across 44 U.S. States, Guam, and PR. Changes and updates to the database this quarter include the following:

- Addition of 2,382 turbine records. Additions include:
 - 2,382 new turbines.
- Removed 116 turbine records. Removals include:
 - 75 decommissioned turbines.
 - 4 reclassified as "not a turbine" (Either another structure mislabeled, or nothing in imagery >2 years after "built date").
 - 37 duplicate turbines removed.
- A total of 18,481 attribute changes were made. These include:

▪ 817 "faa_asn" updates.	▪ 47 "t_hh" updates.
▪ 2 "t_county" updates.	▪ 1,640 "t_rd" updates.
▪ 2 "t_fips" updates.	▪ 1,640 "t_rsa" updates.
▪ 927 "p_name" updates.	▪ 1,640 "t_ttlh" updates.
▪ 181 "p_year" updates.	▪ 2,156 "t_conf_atr" updates.
▪ 2,223 "p_tnum" updates.	▪ 1,226 "t_conf_loc" updates.
▪ 124 "p_cap" updates.	▪ 2,005 "t_img_date" updates.
▪ 425 "t_manu" updates.	▪ 399 "t_img_srce" updates.
▪ 1,813 "t_model" updates.	▪ 66 "xlong" updates.
▪ 1,094 "t_cap" updates.	▪ 54 "ylat" updates.

VII. NUMBER OF WIND TURBINES BY STATE:

The USWTDB currently includes wind turbines from 44 U.S. states, plus Guam and Puerto Rico. Table 2 reports the number of turbines in each of these states and territories for the current release (Q4-2020) as well as the previous quarterly release (Q3-2020) for comparison. The changes by state reported in Table 2 may be due to turbines added to the dataset (via FAA and AWEA data) and/or duplicate and decommissioned turbines removed from the dataset.

Table 2: Summary of Turbines by State

State	Q3-2020	Q4-2020	Change	State	Q3-2020	Q4-2020	Change
AK	142	142	0	ND	2,121	2,182	61
AR	1	1	0	NE	1,385	1,385	0
AZ	146	241	95	NH	84	84	0
CA	6,833	6,834	1	NJ	6	6	0
CO	2,741	2,749	8	NM	1,259	1,481	222
CT	3	3	0	NV	68	68	0
DE	1	1	0	NY	1,142	1,149	7
FL	2	2	0	OH	503	503	0
GU	1	1	0	OK	4,397	4,490	93
HI	132	132	0	OR	2,064	2,064	0
IA	5,723	5,856	133	PA	751	752	1
ID	541	541	0	PR	63	63	0
IL	3,141	3,274	133	RI	32	32	0
IN	1,371	1,486	115	SD	1,060	1,260	200
KS	3,507	3,614	107	TN	18	18	0
MA	92	92	0	TX	15,895	16,293	398
MD	80	80	0	UT	208	208	0
ME	392	411	19	VA	2	2	0
MI	1,337	1,483	146	VT	73	73	0
MN	2,698	2,759	61	WA	1,772	1,824	52
MO	886	1,065	179	WI	452	452	0
MT	556	650	94	WV	396	396	0
NC	105	105	0	WY	1,366	1,507	141
				TOTAL	65,548	67,814	2266

VIII. CONFIDENCE IN TURBINE LOCATIONS:

The level of confidence¹ in turbine latitude/longitude coordinates remains very high, thanks to the visual verification efforts from USGS. Currently, 62,633 (92.4%) turbine points have high location confidence, and only 7.0% of turbines have low location confidence. 100% of the turbine locations in this dataset have been visually examined using satellite imagery. Location confidence of points is summarized in Table 3.

Table 3: Level of confidence in turbine locations

Location Confidence	Q3-2020		Q4-2020	
	Freq.	Percent	Freq.	Percent
(3) High	61,156	93.3%	62,633	92.4%
(2) Partial	344	0.5%	446	0.7%
(1) Low/none	4,048	6.2%	4,735	7.0%
(0) Not checked	0	0.0%	0	0.0%

We are aware of the existence of turbines in the dataset that have a *high* location confidence but have been dismantled. These would be turbines that were previously verified but have since been decommissioned. If users are aware of any turbines that have been dismantled but remain in the dataset please send an email to uswtodb@lbl.gov with details about them, or use the “submit a suggested correction” button via the USWTDB online viewer. Note that the *case_id* for the turbine being corrected will automatically be included if you use the button via the viewer. If you submit a correction via email, please include *case_id*.

¹ **Location confidence** (conf_loc) is rated on a 0-3 scale:

- 0—Not visually verified (these points are in the queue for verification in the next quarter)
- 1—No turbine shown in image; image has clouds; imagery older than turbine built date
- 2—Partial confidence: image shows a developed pad with concrete base and/or turbine parts on the ground
- 3—Full confidence: image shows an installed turbine or a tower being constructed; at least partially installed

IX. CONFIDENCE IN TURBINE ATTRIBUTES:

The level of confidence² in the attributes (such as total height, hub height, and rotor diameter) of each wind turbine remains high. We have high confidence in attributes for 83.9% of the turbines, partial confidence in 4.6% of turbines, and low or no confidence in 11.5%. Turbine points are categorized as “partial” confidence if the AWEA attribute data conflicts substantially³ with existing records. Attribute confidence is summarized in Table 4.

Table 4: Level of confidence in turbine attributes

Attribute Confidence	Q3-2020		Q4-2020	
	Freq.	Percent	Freq.	Percent
(3) High	54,839	83.7%	56,910	83.9%
(2) Partial	4,532	6.9%	3,107	4.6%
(1) Low/none	6,177	9.4%	7,797	11.5%
(0) Not checked	0	0.0%	0	0.0%

The seven attributes that are collected are well populated across the dataset. Each attribute is populated in at least 87% of turbines, and over 87% of turbines in the USWTDB have data populated in *all seven* turbine attributes. Attribute data are summarized in Table 5.

Table 5: Number of turbines with data populated and summary statistics for seven turbine attributes

Turbine Attribute	# of Turbines	% of Turbines	Minimum	Median	Maximum
Project year	67,078	98.91%	1981	2012	2020
Total height (m)	59,435	87.64%	30.4	126.2	199.6
Hub height (m)	59,435	87.64%	19	80	131
Rotor diameter (m)	59,716	88.06%	11	91.5	154
Capacity (kW)	60,369	89.02%	50	1800	6000
Turbine Manufacturer	60,486	89.19%	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
Turbine Model	60,050	88.55%	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<i>All Seven Attributes</i>	<i>59,285</i>	<i>87.42%</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>

² **Attribute confidence** (conf_attr) is rated on a 1-3 scale:

1—No confidence: no facility data, no name, nothing in publications

2—Partial confidence: incomplete information or substantial conflict between data sources

3—Full confidence: consistent information across multiple data sources

³ A “substantial” conflict was defined as any of the following differences (+/-): p_year 4 years; t_hh 10 meters; t_rd 10 meters; t_ttlh 50 feet; t_cap 250 kW. These tolerances will also be examined in the coming quarters and are expected to tighten over time.